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Operating Instructions

DV04

High - precision
Gearwheel flow meter for
viscous liquids

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1 Introduction

Series DV04 gearwheel flow meters are noted for their reliable function and easy operation. To obtain the greatest benefit from this device, please observe the following cautionary statement:

Persons who are responsible for setting up or operating this device must be sure to read the and understand the operating instructions and the safety information pertaining to it.

2 Safety Information

2.1 General Instructions

To ensure safe operation, the device must only be operated according to the information in the operating instructions. When the device is in use, the regulations and safety standards applicable to the specific application must also be observed. This statement also applies to the use of accessories.

2.2 Proper Usage

Series DV04 gearwheel flow meters are designed for the continuous measurement of the flow of low viscous fluids.

Any application extending beyond this specific intended use does not constitute proper usage. Series DV04 must not be employed as the sole means of avoiding hazardous conditions in machinery and installations.

The machinery and installations must be designed in such a manner that faulty conditions and malfunctions will not present hazardous situations for operating personnel.

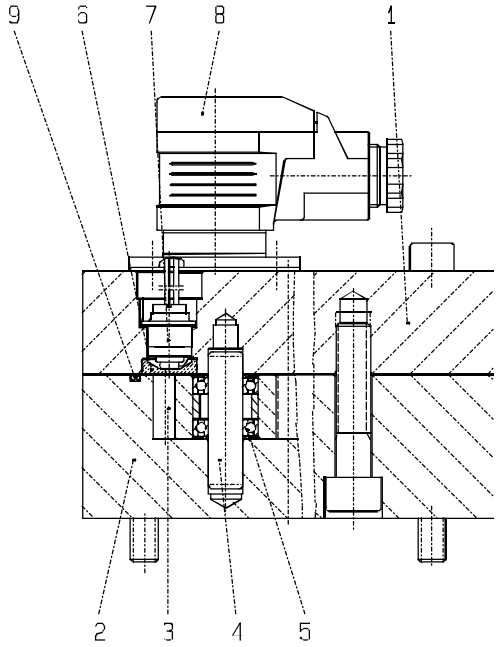
2.3 Qualified Personnel

Series DV04 must only be used by qualified, knowledgeable personnel trained in correct use of these devices. Qualified personnel are those persons familiar with setting up and assembling these devices, placing them in service and operating them. In addition, such personnel must also be qualified to perform the work associated with the application for which the device is being used.

3 Functional Description and Design

Within the DV04 there two gearwheels that are supported in low-friction bearings. During operation, the gearwheels are driven by the flowing liquid. The movement of the gearwheels is sensed by two non-contact sensors located in the cover and converted into electrical signals. Between the sensor area and the measuring chamber there is a pressure-resistant antimagnetic separator. The signals are transmitted to the connected display device.

1 Cover
2 Housing
3 Gearwheel
4 Journal
5 Bearing
6 Anti-magnetic separator
7 Sensor
8 Device connector
9 O-ring



4 Special Conditions

Special conditions and/or limitations apply to the safe application of gearwheel flow meters in the approved operating environment. These conditions and/or limitations must be met by the customer and/or system operator by means of appropriate technical and/or organizational measures.
Gearwheel flow meters must only be operated in the specified environment and under the specified ambient conditions.
Gearwheel flow meters must only be used if the materials used in their construction are resistant to mechanical and/or chemical influences or corrosion under the given service conditions.
The fluid must at least have minimum lubricating properties (lubricity).
Gearwheel flow meters are intended for use with liquids. Dry operation is not approved.
Operation outside of the specified parameters is not allowed.
If necessary, a filter must be installed to prevent the gearwheel from being blocked by foreign objects.
The specified installation, service and maintenance schedules must be strictly followed.
Gearwheel flow meters must only be used in closed operation and not be subject to excessive vibration.
Only genuine spare parts must be used for service and maintenance.

5 Installation and Removal of the Gearwheel Flow Meter

This gearwheel flow meter was thoroughly tested and checked at the factory before shipment. It will be fully functional and immediately ready for use after it has been installed in position and the electrical lines have been connected. The space required by the installed device is specified in the "Dimensions" section. Once installed, the measuring device should also be accessible for safe, visual inspection at any time.

Caution: To prevent possible damage to the gearwheel flow meter, a pressure regulating device must be present in the installation to prevent the maximum permissible pressure from being exceeded in the volume sensor or other parts of the installation (pressure-limiting valves). During transport and installation, the gearwheel flow meter must only be held by its housing; must never be suspended from the plugged-in connector!

6 Corrosion Protection

All gearwheel flow meters are checked for proper function at the factory with mineral-based hydraulic oil. Following testing, the connections are sealed with plugs so that the internal parts are protected against corrosion for a moderate amount of time. During transport and storage, gearwheel flow meters must not be exposed to the harmful effects of ambient weather conditions and great variations in temperature. They must be stored under dry conditions.
If a gearwheel flow meter is to be stored for a longer period of time, both its interior and exterior must be protected by application of a suitable anti-corrosion oil. In addition, it must be protected from humidity by means of a desiccant material.
If high humidity or other unfavorable (aggressive, polluted) ambient conditions are expected to be encountered during transport, appropriate steps must be taken to prevent corrosion of the gearwheel flow meter.

Caution: When applying an anti-corrosion treatment, first check to be sure that the material to be used is compatible with the elastomers used in the construction of the gearwheel flow meter and will not harm them. You should also check that the material used is compatible with the fluid flowing through the flow meter.

7 Mechanical Installation

Depending on the installation, the device is connected to the system by means of a connection plate or pipe connections in its housing.

Caution: Only piping and connections that are approved for the expected pressure range may be used. The specifications of the respective manufacturer must be followed. The device must be installed so that it is not subject to excessive vibration. Installation above hot parts is not allowable since liquids that could possibly leak from the device may then be ignited. When being placed in operation, the device must be checked for leaks under normal operating conditions.

Connection Plate
Before installing the gearwheel flow meter, carefully clean the piping system. Then mount the connection plate at the prescribed location in the system.

Caution: Make sure that the gaskets are seated properly! The joint surface must be free of dirt and paint residue
Place the housing on the connection plate so that the mounting holes are in alignment.
Fasten the housing to the connection plate with the screws and tighten them down.

Caution: The mounting screws for the DV04 mountings plate must be tightened crossways. Be sure to apply the correct amount of torque.

Installation on connection plates not supplied with the device or on valve manifolds
Be sure to observe the specified values for surface flatness and surface roughness.

Nominal size	DV04.2-6	DV04.7-8
Surface roughness R_t 1/ 1000 mm	0.01	0.02
Surface flatness 1/ 1000 mm	10	10

In this case, the gearwheel flow meter must also be installed as described above.

Pipe Connection

- Before installing the gearwheel flow meter, completely clean the piping system.
- Connect the piping to the inlet and outlet of the measuring device. Be sure to observe the specifications of the respective manufacturer.
- During installation be sure than no sealant gets inside the piping system.

Caution: The gearwheel flow meter must not be subjected to excessive mechanical stress during installation.

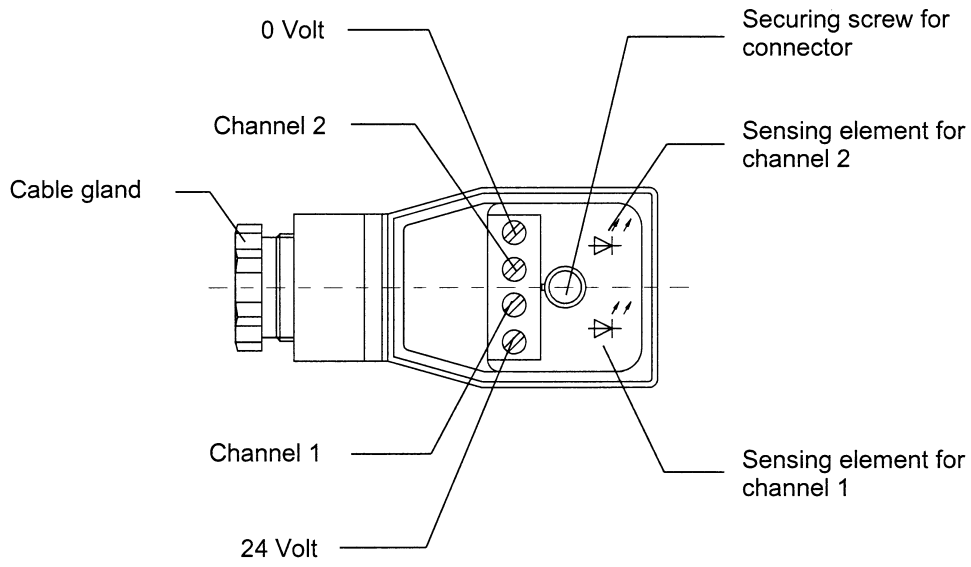
- After the gearwheel flow meter is installed and the piping system is placed back in service, check all connections for leakage.

8 Electrical Connection

Number of measuring channels	2
Operating voltage	U_B = 24 V DC +/- 20%, protected against polarity reversal
Pulse amplitude	U_A >/= 0,8 U_B
Pulse from with symmetric output signal	Square-wave pulse, scanning ratio /channel 1:1 +/- 15%
Pulse offset between both channels	90° +/- 30°
Power consumption	$P_{b\,max}$ = 0,9 W
Output power / channel	$P_{a\,max}$ = 0,3 W, short circuit proof
Protection type	IP 65 (DIN 40500)

Prerequisite:
A 24V (DC) line (± 20 %) must be provided to supply power to the pre-amplifier.

The terminal assignment for channel 1 or 2 has an influence on the displayed direction of rotation of the gearwheels, and thus on the preceding sign (+ or -) that is used when displaying the measured volumetric flow rate on the evaluation device.



Caution: After assembly, the mounting screw (slightly) and the cable gland nut must be tightened

9 Maintenance and Cleaning

Gearwheel flow meters are generally maintenance-free. However, if fluids that can leave deposits flow through the device, cleaning may be necessary. Otherwise, the device can be cleaned with the rest of the system during the standard cleaning procedure. Indications of wear may be evident by a change in measuring accuracy. It is recommended the device be inspected regularly.

Caution: If fluids harden in the gearwheel flow meter, it must be cleaned as quickly as possible with suitable cleaning agents.

The mounting screws must be regularly checked for tightness. If necessary, retighten them (in such case, observe the tightening torque specified in the section ” Installation and Removal of the Gearwheel Flow Meter”).

Caution: Be sure to relieve the pressure in the piping before performing any work on the gearwheel flow meter or removing it. The gaskets in the joints between the gearwheel meter and the piping system must be checked regularly for leakage.

Cleaning

Devices in series 1, 2, 6, 7 and 8:
These devices must never be opened by the customer. They must only be opened by trained service personnel because only such specialists can reassemble them properly so that they will function correctly.
Devices in series 3, 4 and 5:
If due care is used, these devices may be opened and cleaned by the customer.

Caution: Be sure to relieve the pressure in the piping and ensure that the electrical supply is de-energized before opening and cleaning the device. The device and the piping may still contain the transported fluid or a cleaning agent. All guidelines governing the handling of the fluid that was last sent through the system must be followed. Before opening the system, make sure that containers of sufficient capacities are available to catch any escaping fluid. If necessary, the work area must also be sufficiently ventilated.

- Removing the gearwheel flow meter (see section ” Installation and Removal of the Gearwheel Flow Meter”).
- Drain the measuring device.
- Loosen the screws that hold the two halves of the housing together bolts.
- The 4 or 8 internal hexagon drive screws ("Allen screws) are accessible from the bottom of the housing.

Caution: When removing the upper half of the gearwheel flow meter, do not pry the halves apart at the joint with screwdrivers or similar tools. The gearwheels must not be removed from the housing with pliers or similar tools.

- Clean the interior of the housing, the gearwheels and the bearings with a suitable cleaning agent.
- Insert both gearwheels with the bearings in the lower housing.
- Position the o-ring in the grooved seat in the housing.
- Place the upper part of the housing on the bottom part (insert the locating pins).
- Insert the screws and snug them down crossways. Then tighten them crossways to the specified torque (see below).

Caution: All parts being assembled must be free of dirt and deposits. During installation of the gearwheel flow meter, make sure that no foreign objects enter the assembly.

Nominal Size*	DV04.2	DV04.3	DV04.4	DV04.5	DV04.6	DV04.7	DV04.8	DV04.9
Tightening Torque Nm	14	14	14	35	35	120	120	290

Install the housing again in the system as described in the section ” Installation and Removal of the Gearwheel Flow Meter” .

10 Returning

If service or repair to the device is necessary or if the device needs to be inspected at the factory, it must be suitably packed for shipment. Furthermore, the device must be accompanied by a material safety data sheet indicating the fluid that was used in it. In the case of common mineral oils, an exact type designation is required.

Caution: If the device was used with fluids whose residues will become hard or sticky, it must be rinsed out before being returned.

11 Disposal

The device packing material as well as used devices and device parts must be disposed of in accordance with applicable regulations of the country in which the device is installed.

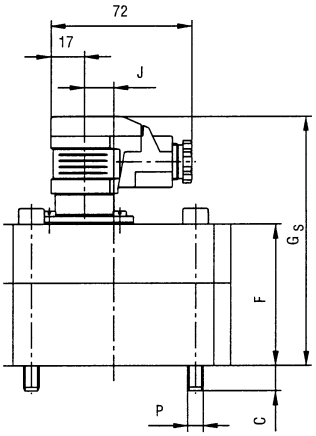
12 Troubleshooting

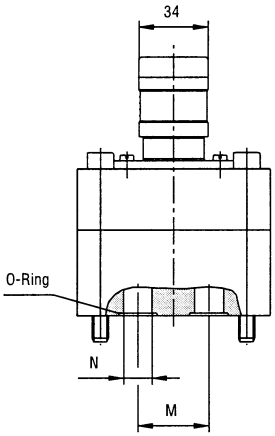
Error	Possible cause	Remedy
The two LED displays on the isolating switch amplifier are illuminated, but incorrect values are displayed.	The connection between gearwheel flow meter and evaluation device is faulty.	Check the connection and, if necessary, replace the cable or plug connector.
One of the LED displays does not illuminate during operation.	The wiring between the sensor and the circuit board or individual soldered points on the circuit board are damaged.	Return the measuring device to the manufacturer for repair.
	The associated sensor is faulty.	
The two LED displays do not illuminate during operation.	No voltage supply present	Check the power cable and fuses.
	Since it is unlikely that both sensors will fail at the same time, it should then be assumed that the measuring mechanism has stopped for some reason.	**Immediately remove the gearwheel flow meter from operation!** Return devices in series 1, 2, 6, 7 and 8 to the manufacturer for repair. Devices in series 3, 4 and 5 may be disassembled and cleaned (see "Maintenance").
Leakage, fluid leak	O-ring in housing defective, allowing leakage.	Return devices in series 1, 2, 6, 7 and 8 to the manufacturer for repair and request advice on the specific application. Check devices in series 3, 4 and 5 for seal compatibility with the particular fluid being transported. If necessary contact the manufacturer and install a new gasket set (can be ordered from the manufacturer).
	O-ring between gearwheel flow meter and connection plate defective, allowing leakage.	Check seal compatibility, install new O-rings.
Reduced measuring accuracy	Device wear	Check measuring device or return to the manufacturer for repair.

13 Dimensions (series 1,2,3,4,7)

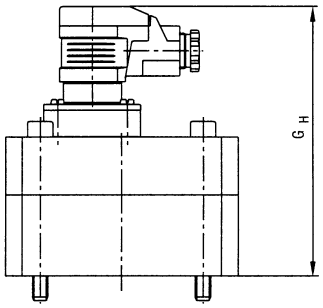
Model	Weight*	A	C	D	F	GS	GH	J	K	L	M	N	P
DV04.2	1,8	85	10	60	50	101	114	-	70	40	20	6,5	M6
DV04.3	2	85	9	60	56	107	120	-	70	40	20	6,5	M6
DV04.4	2	85	13	60	57	108	121	-	70	40	20	9	M6
DV04.5	3,7	100	17	90	63	114	127	-	80	38	34	16	M8
DV04.6	5,2	120	13	95	72	123	136	15,5	84	72	35	16	M8
DV04.7	9	170	18	120	89	140	153	46,5	46	95	50	25	M12
DV04.8	13	170	22	120	105	156	169	46,5	46	95	50	25	M12
DV04.9	35,5	200	25	160	121	172	-	-	64	125	70	38	M16

* in Kg



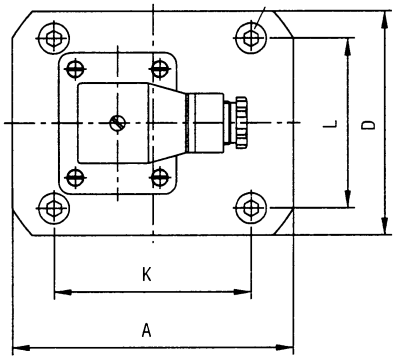


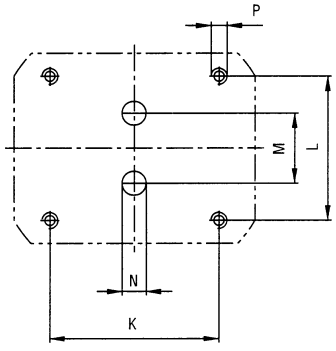
Design S and X



Design H

Connection Dimensions

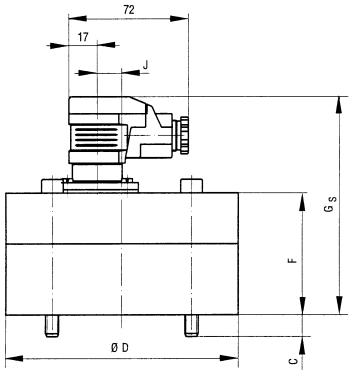


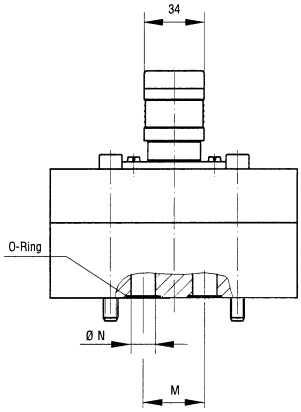


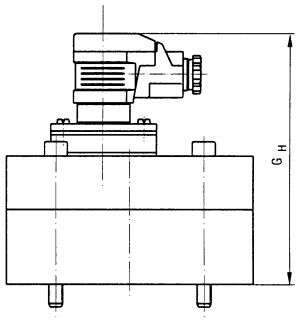
Dimensions (series 5,6,8, stainless steel version)

Model	Weight*	C	D	F	GS	GH	J	K	L	M	N	P
DV04.2	3	15	94	55	106	119	-	70	40	20	6,5	M6
DV04.3	3	9	94	56	107	120	-	70	40	20	6,7	M6
DV04.4	3,1	13	94	57	108	121	-	70	40	20	9	M6
DV04.6	7	13	124	72	123	136	15,5	84	72	35	16	M8
DV04.7	15,9	21	170	89	140	153	46,5	46	95	50	25	M12
DV04.8	18,7	25	170	105	156	169	46,5	46	95	50	25	M12

* in Kg

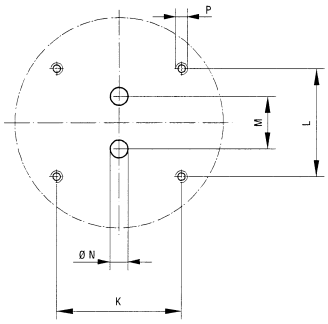


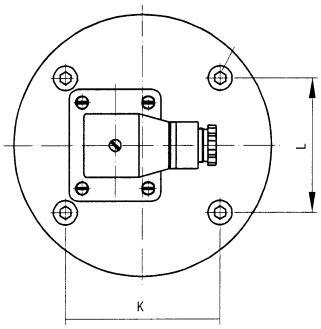




Design S and X **Design H**

Connection Dimensions

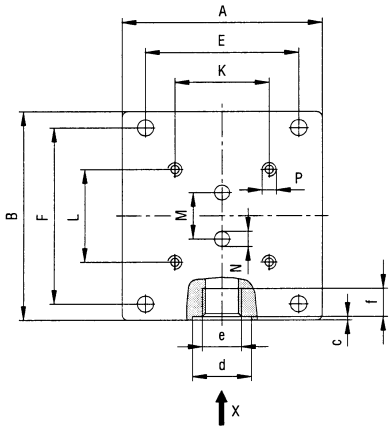




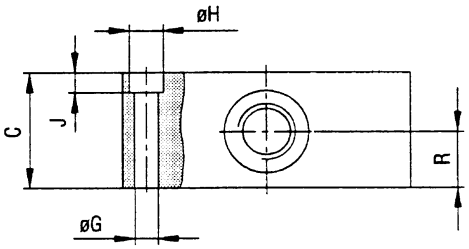
Connection flanges (cast iron)

Model	Weig..*	A	B	C	E	F	G	H	J	K	L	M	N	P	R	c	d	e	f
DV04.2-DV04.4	1,8	85	90	35	65	76	7	11	7	70	40	20	6,5	M6	17	0,7	25	G3/8	13
DV04.5	2,7	100	110	37	86	96	7	11	7	80	38	34	16	M8	18,5	0,7	29	G1/2	15
DV04.6	2,9	100	120	37	80	106	7	11	7	84	72	35	12	M8	17,5	0,7	29	G1/2	15
DV04.7	4,9	100	120	65	80	106	7	11	8	84	72	35	13	M8	32,5	1	42	G1	19
DV04.8	14	160	165	80	140	145	9	15	9	46	95	50	25	M12	28	1	42	G1	19
DV04.9	28	200	215	100	176	191	11	18	11	64	125	70	38	M16	35	1	58	G 1 1/2	23

* in kg



View X



DV04

High-precision Gearwheel flow meter for viscous liquids

- **For fluids with viscosities of at least 20 cSt**
- **Very cost effective**
- **Cast iron or stainless steel designs available**
- **Accuracy better than 0.3% of measured value**
- **High resolution**
- **Pressure-proof construction withstands up to 400 bar**
- **Small installation dimensions**

Description:

The measuring mechanism in the DV04 flow meter consists of a pair of gearwheels that are driven by the fluid stream, much like a gearwheel pump. The measuring mechanism is supported by sleeve bearings or ball bearings. Two anti-magnetic sensors, with a relative phase offset of 90° and hermetically isolated from the measuring chamber, sense the movement of the gear wheels. This two-channel sensing system used with appropriate electronics permits a higher measurement resolution as well as detection of flow direction. All flow meters are optionally available in a explosion-proof design with a separate switching amplifier. The DV04 gearwheel flow meter features very low resistance to flow and particularly low sound pressure levels.

Applications:

Their outstanding measuring accuracy and high resolution make these devices particularly suitable for use in test stands when measuring small and very small flow volumes.

Other areas of application:
- Measuring consumption rates
- Controlling and regulating filling processes
- Dosing of oils and chemicals
- Flow measurement of paints and varnishes
- Controlling the ratio of polyalcohol/polyhydroxy alcohol and isocyanate

PKP PROCESS INSTRUMENTS

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Designs (table 1)

Depending on application and medium properties, the DV04 is available in 8 different model ranges:

Series	Material	Minimum viskosity (mm²/s)	Accuracy (% of measured value)	Medium properties	
				Viskosity	Lubricity
1	GGG40	20	+/- 0.3	low	good
2	GGG40	50	+/- 0.5	average	good
3	GGG40	100	+/- 1.0	high	good
4	GGG40	100	+/- 0.5	average	low
5	stainless steel 1.4404	100	+/- 0.5 DV04.2: +/- 3	average	low
6	stainless steel 1.4404	20	+/- 0.3	low	good
7	GGG40	20	+/- 1	low	low
8	stainless steel 1.4404	20	+/- 1	low	low

Process connection (table 2)

Baureihe	1	2	3	4	5	6	7	8
bearing / Type	ball-bearing	ball-bearing	bronze sleeve-bearing	Hard alloy sleeve-bearing	Hard alloy sleeve-bearing	ball-bearing	Hybrid-ball bearing	Hybrid-ball bearing
DV04.2	G 3/8	-	-	-	G 1/8	G 1/8	G 3/8	G 1/8
DV04.3	G 3/8	-	-	-	-	G 1/4	G 3/8	G 1/4
DV04.4	G 3/8	G 3/8	-	G 3/8	G 3/8	G 3/8	G 3/8	G 3/8
DV04.5	G 1/2 or G 3/4	-	-	G 1/2 or G 3/4	-	-	-	-
DV04.6	G 1/2 or G 3/4	G 1/2 or G 3/4	G 1/2 or G 3/4	G 1/2 or G 3/4	G 1/2	G 1/2	G 1/2 or G 3/4	G 1/2
DV04.7	G 1	G 1	-	G 1	G 1	G 1	-	-
DV04.8	G 1	G 1	G 1	G 1	G 1	G 1	-	-
DV04.9	G 1 1/2	-	-	-	-	-	-	-
DV04.10	G 1 1/2	-	-	-	-	-	-	-

Measuring ranges in l/min (table 3)

Model	Range							
	1	2	3	4	5	6	7	8
DV04.2	0,008-2	-	-	-	0,02 - 2	0,008-2	0,008-2	0,008-2
DV04.3	0,02-4	-	-	-	-	0,02-4	0,02-4	0,02-4
DV04.4	0,16-16	0,16-16	-	0,16-16	0,16-16	0,16-16	0,16-16	0,16-16
DV04.5	0,2-40	-	-	0,2-30	-	-	-	-
DV04.6	0,4-80	0,4-80	0,6-40	0,3-60	0,3-60	0,4-80	0,4-80	0,4-80
DV04.7	0,6-160	0,6-160	-	0,6-100	0,6-100	0,6-160	-	-
DV04.8	1-250	1-250	1,2-80	1-160	1-160	1-250	-	-
DV04.9	2-600	-	-	-	-	-	-	-
DV04.10	3-700	-	-	-	-	-	-	-

Parameters (table 4)

Model	Maximum pressure (bar)	Peak pressure (bar)	Sound pressure level (dB(A))	Resolution impulses / l
DV04.2	400	480	< 60	40.000
DV04.3	400	480	< 60	25.000
DV04.4	400	480	< 60	4.081,63
DV04.5	400	480	< 70	2.500
DV04.6	400	480	< 70	965,25
DV04.7	315	350	< 70	333,33
DV04.8	315	350	< 72	191,5
DV04.9	400	480	< 80	83,33
DV04.10	400	480	< 80	62,5

Model coding:

Order number: DV04 | 3. | 1. | F. | PS.. | 10. | S. | 0

Gearwheel flow meter

Measuring ranges:
2…9 = as per table 3

Series:
1…8 = as per table 1

Seal:
F = Viton
E = EPDM
P = PTFE / Kalrez

Connection:
PS = with mounting plate, connection at the side
PU = with mounting plate, connection at bottom
R = without mounting plate, connection at the side (model ranges 5, 6, 8 only)

Process connection (see table 2):
04 = G 1/8 IG
05 = G 1/4 IG
10 = G 3/8 IG
15 = G 1/2 IG
20 = G 3/4 IG
25 = G 1 IG
40 = G 1 1/2 IG

Electronics:
S = Standard
H1 = High-temperature-design up to 150 °C
H2 = High-temperature-design up to 220°C (FEP-Gasket and clamp-connection)
X = Intrinsically safe with separate switching amplifier (EEx ia IIC)

Special features:
0 = None
1 = Please specify in writing

Technical details:

Viscosity range: 20 to 100000 mm²/s

Pressure loss: depends on viscosity and load on the device (exact values available upon request)

Temperature range:
- **Standard design:** –30... +120 °C
- **High-temperature design:** –30...+150 °C

Materials:
- **Series 1-4, 7:** housing GGG 40, GGG60 (DV04.9, DV04.10)
  Measuring mechanism 1.7139
- **Series 5, 6, 8:** housing stainless steel 1.4404
  Measuring mechanism stainless steel 1.4462

Electronics:
- **Standard:** 2 sensors, 90° phase offset
- **Ex-design:** with separate switching amplifier

Supply voltage: 12…30 VDC, Protected against polarity reversal

Output signal: Square-wave pulse, minimum 0.8*UB, Scanning ratio 1:1 (± 15%)

Protection type: IP 65

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